

### Brief Technical Note

## CULTURE OF ARTEMIA ON RICE BRAN: THE CONVERSION OF A WASTE-PRODUCT INTO HIGHLY NUTRITIVE ANIMAL PROTEIN<sup>1</sup>

PATRICK SORGELOOS\*,\*\*, MARITÉ BAEZA-MESA\*\*, ETIENNE BOSSUYT\*\*, ERIC BRUGGEMAN\*\*, JOHN DOBBELEIR\*\*, DANNY VERSICHELE\*\*, EINSTEIN LAVIÑA\*\*\* and ARTEMIO BERNARDINO\*\*\*

\*Senior Research Scientist at The Belgium National Foundation for Scientific Research (N.F.W.O.)

\*\*Artemia Reference Center, State University of Ghent, Plateaustraat 22, B-9000 Ghent (Belgium)

\*\*\*SEAFDEC-Aquaculture Department, Tigbauan Center, P.O. Box 256, Iloilo City (The Philippines)

<sup>1</sup> Contribution No. 65 of the Aquaculture Department, SEAFDEC

(Accepted 12 January 1980)

### ABSTRACT

Sorgeloos, P., Baeza-Mesa, M., Bossuyt, E., Bruggeman, E., Dobbeleir, J., Versichele, D., Lavina, E. and Bernardino, A., 1980. Culture of *Artemia* on rice bran: the conversion of a waste-product into highly nutritive animal protein. *Aquaculture*, 21: 393-396.

The age-old problem of finding a cheap and suitable food for *Artemia* is finally solved with rice bran, in fact a waste-product which is available at a very low price in many countries all over the world.

Of the various batch culturing techniques we have tested for growing *Artemia* larvae from nauplius to adult, the air-water-lift operated raceway proves to be the most suitable. The construction and operation of the culture tank are simple, and high production results can be obtained. A detailed description of this culturing technique is reported in Bossuyt and Sorgeloos (1980).

Although it is known from the literature that a wide range of live and inert feeds can successfully be used in culturing brine shrimp (see review in Sorgeloos and Persoone, 1975), a cheap food, available world-wide, has not yet been reported.

For more than 2 years now, we have been using rice bran, i.e. the broken coat of the rice grain, as a most suitable diet for brine shrimp. This waste-product of a major agricultural crop is available in large quantities on most continents at a wholesale price of less than US \$ 0.15/kg.

In our experience, good results are guaranteed only when the rice bran is free of contamination by pesticides, which are often applied during long-term transport or storage of the crude product. When available, defatted rice bran

is to be preferred: compared with crude rice bran it is as good a food for brine shrimp but is cheaper and more stable, i.e. less liable to become rancid (Dobbeleir et al., 1980).

The particle size of the *Artemia* food should be under 50 µm. As regards the local costs of manpower, manual preparation or mechanical grinding can be applied. The manual method consists of wet homogenization in a blender followed by screening the suspension through a 50-µm filter screen. Dry processing techniques, such as Ultrafine®-micronization, are now available to reduce particle sizes below the 50-µm level. These applications however, are economically feasible only for large quantities. More details on the processing of rice bran and the selection of other cheap inert feeds for *Artemia* are reported in Dobbeleir et al. (1980).

Although the nutritional value of rice bran as a sole food for fishes and crustaceans is known to be very low, it appears to be an excellent diet for brine shrimp. After 2 weeks batch culturing in a 1-m<sup>3</sup> raceway at 28°C, the nauplii hatched out of 10 g cysts are converted into approximately 2 kg live-weight pre-adults. Rice bran can also be used for flowthrough culturing of brine shrimp (Tobias et al., 1979; Sorgeloos, 1980). Preliminary tests indicate

TABLE I

Amino acid composition (expressed as percentage of the dry weight) of rice bran (Barber and Benedito de Barber, 1977), naturally-grown adult San Francisco Bay *Artemia* (Gallagher and Brown, 1975), and pre-adult *Artemia* cultured from San Francisco Bay cysts in an AWL-raceway on homogenized rice bran

	Rice bran	Naturally-grown <i>Artemia</i>	Rice-bran-fed <i>Artemia</i>
Crude protein	13.4	58	60
Lysine	0.49	3.27	4.00
Histidine	0.27	0.77	1.18
Arginine	0.82	2.80	4.05
Aspartic acid	0.97	3.96	4.53
Threonine	0.39	1.98	2.50
Serine	0.54	2.06	2.52
Glutamic acid	1.63	6.11	6.41
Proline	0.52	2.24	4.00
Glycine	0.57	2.28	2.65
Alanine	0.72	2.97	3.50
Cystine	0.21	0.95	0.90
Valine	0.69	2.32	2.49
Methionine	0.28	1.16	1.39
Isoleucine	0.50	2.28	2.53
Leucine	0.88	3.44	3.40
Tyrosine	0.46	1.93	2.75
Phenylalanine	0.57	2.02	2.84
Total amino acids	10.51	42.54	51.14

that up to five times more biomass can be produced per unit of tank volume as compared with results obtained with batch culturing.

The amino acid data in Table I indicate that brine shrimp, at least at the qualitative level, are very efficient protein converters. Although their food contains only low levels of plant protein, 60% of the adult dry weight is composed of an animal protein which is rich in essential amino acids.

It appears from Table II that there are important differences in the fatty acid pattern of natural brine shrimp and those fed rice bran. Nevertheless, no significant differences in growth or survival were reported when sole (*Solea solea*) and lobster (*Homarus americanus*) larvae, respectively, were fed 2-day-old or adult *Artemia* fed rice bran versus *Spirulina* (Dobbeleir, 1979 and non published data).

However, in view of the essential role of long-chain poly-unsaturated fatty acids in the diet of larval fishes (Watanabe et al., 1978), further research will be devoted to determining the nutritional value of rice-bran-fed *Artemia* for various predators, as well as to the potential of modifying the fatty acid pattern in *Artemia* through diet modifications and/or alternations (cf. Dobbeleir et al., 1980).

TABLE II

Fatty acid analysis of the lipid fraction (expressed as percentage of the total fraction) of naturally-grown adult San Francisco Bay *Artemia* (Gallagher and Brown, 1975) and pre-adult *Artemia* cultured from San Francisco Bay cysts in an AWL-raceway on homogenized rice bran

Fatty acid	Naturally-grown <i>Artemia</i>	Rice-bran-fed <i>Artemia</i>
14 : 0	1.4	0.74
14 : 1	2.3	0.68
15 : 0	0.7	0.23
15 : 1	0.8	
16 : 0 branched		0.33
16 : 0	13.5	11.87
16 : 1	13.8	6.60
17 : 0	1.3	0.03
17 : 1	0.9	
18 : 0 branched		0.13
18 : 0	5.9	5.56
18 : 1	35.6	41.66
18 : 2	6.2	25.66
18 : 3		3.55
20 : 0	2.0	
20 : 1		
20 : 4	2.2	
20 : 5	12.0	
21 : 0		1.62
21 : 1		1.30

## ACKNOWLEDGEMENTS

We are very indebted to Dr. ir. A. Hughebaert for the fatty acid analysis, to RADAR-Deinze for the amino acid analysis, and to Mr. R. Foblets for his continual help in defining and developing suitable rice bran sources for *Artemia*.

## REFERENCES

- Barber, S. and Benedito de Barber, C., 1977. Basic and applied research needs for optimizing utilization of rice bran as food and feed. In: S. Barber and E. Tortosa (Editors), Proceedings of the "Rice By-products Utilization" International Conference, Valencia (Spain), 30 Sept.-2 Oct. 1974. Instituto de Agroquimica, Technologica de Alimentos, Valencia (Spain), pp. 1-99.
- Bossuyt, E. and Sorgeloos, P., 1980. Technological aspects of the batch culturing of *Artemia* in high densities. In: G. Persoone, P. Sorgeloos, O.A. Roels and E. Jaspers (Editors), The Brine Shrimp *Artemia*. Vol. 3. Ecology, Culturing, Use in Aquaculture. Universa Press, Wetteren (Belgium), in press.
- Dobbeleir, J., 1979. Verslag van de werkzaamheden tijdens het eerste mandaat van het IWONL: het op punt stellen van een geschikt dieet voor het pekelkreeftje *Artemia* spec. *Artemia* Reference Center, State University Ghent, 76 pp.
- Dobbeleir, J., Adam, N., Bossuyt, E., Bruggeman, E. and Sorgeloos, P., 1980. New aspects of the use of inert diets for high density culturing of brine shrimp. In: G. Persoone, P. Sorgeloos, O.A. Roels and E. Jaspers (Editors), The Brine shrimp *Artemia*. Vol. 3. Ecology, Culturing, Use in Aquaculture. Universa Press, Wetteren (Belgium), in press.
- Gallagher, M. and Brown, W.D., 1975. Composition of San Francisco Bay brine shrimp (*Artemia salina*). J. Agric. Food Chem., 23 (4): 630-632.
- Sorgeloos, P., 1980. The use of *Artemia* in aquaculture. In: G. Persoone, P. Sorgeloos, O.A. Roels and E. Jaspers (Editors), The Brine Shrimp *Artemia*. Vol. 3. Ecology, Culturing, Use in Aquaculture. Universa Press, Wetteren (Belgium), in press.
- Sorgeloos, P. and Persoone, G., 1975. Technological improvements for the cultivation of invertebrates as food for fishes and crustaceans. II. Hatching and culturing of the brine shrimp, *Artemia salina* L. Aquaculture, 6: 303-317.
- Tobias, W.J., Sorgeloos, P., Bossuyt, E. and Roels, O.A., 1979. The technical feasibility of mass-culturing *Artemia salina* in the St. Croix "Artificial Upwelling" Mariculture System. In: Proc. 10th Annu. Meet. WMS, in press.
- Watanabe, T., Oowa, F., Kitajima, C. and Fujita, S., 1978. Nutritional quality of brine shrimp, *Artemia salina*, as a living feed from the viewpoint of essential fatty acids for fish. Bull. Jap. Soc. Sci. Fish., 44(10): 1115-1121.